Collaborative Research Projects in Support of FNMOC Operational Mission

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LONG-TERM GOAL

This project supports applied research at Fleet Numerical Meteorological and Oceanographic Center (FNMOC) with NPS collaborative Master Thesis projects.

OBJECTIVES

This report describes the two collaborative theses in the Department of Meteorology supported by this project in FY2000. They include improvement and evaluation of the FNMOC SSMI sea ice motion algorithm by LCDR Dave Carsten and improved visualization of FNMOC products using Joint METOC Viewer (JMV) by LT Keith Barto.

APPROACH

This "umbrella" effort funds collaborative research projects by NPS Meteorology Department faculty and students and by FNMOC personnel. The specific projects supported under this proposal were developed by mutual agreement between an NPS thesis student, an NPS-Meteorology faculty member (Thesis Advisor) and an FNMOC employee with whom the NPS personnel will collaborate. Projects are approved by the Chairman of the NPS Meteorology Department and by the FNMOC Technical Director. This report will describe the NPS theses completed during FY2000 under this project. All of the theses completed under this effort during FY97, FY98, FY99 and FY00 are listed in the references.

WORK COMPLETED

Two collaborative research projects have been conducted with support received in FY00. LCDR Dave Carsten's thesis project was designed to aid FNMOC (POC: Dr. Jeff Haferman) in evaluation of sea-ice motion analysis techniques using satellite microwave imagery. The ice motion analysis is expected to improve analysis at the Naval Ice Center (NIC) and serve as input to ice motion models (PIPS).

LT Keith Barto was interested in the improvement of FNMOC METOC analysis and forecast visualizations. He is motivated by the following problems: Current Navy METOC weather visualization tools do not allow forecasters and scientists to analyze and co-display environmental data over realistic/accurate topographic and bathymetric backgrounds. Furthermore, forecasters are forced to interpolate model output and perform analysis with no display of terrain information. This can lead

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to reduced final product accuracy; especially in predicting and interpreting model low-level winds. Resultant value of graphics-based products is reduced for end users. Products are less visually useful and appealing. Fleet METOC assets in general are unable to utilize and visualize the terrain data or surface color or land type indexes within the common domain of universal display tools like Joint METOC Viewer which they have available and are trained on.

RESULTS

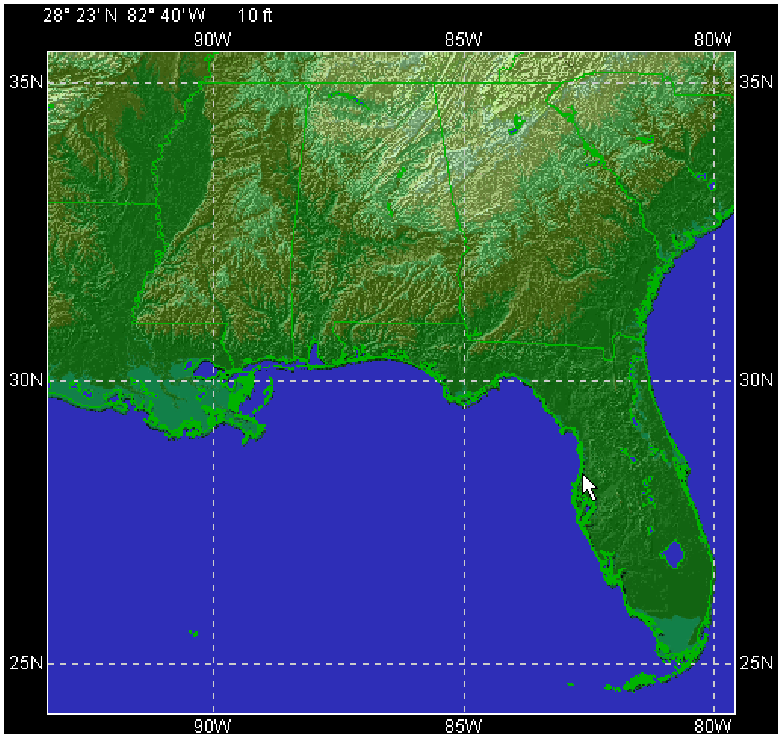
LCDR Dave Carsten's thesis focused on improvement of an ice motion analysis system built by Dr. Walt Meier (Navy Ice Center) and delivered to FNMOC. This system was used to observe Arctic sea ice during the 1999-2000 winter-spring period. Imbedded buoy data was used as ground truth for the satellite microwave ice motion analysis.

Before analysis of ice motions relative to buoy motion, an extensive troubleshooting process was required. Some modification to data projection methods, compositing techniques, and vector selection criteria were necessary. The fundamental conclusion from the study is that ice motions are detectable using the SSM/I motion algorithm and fields of SSM/I vectors are qualitatively consistent with coincident fields of buoy motion vectors. Accuracy of the SSM/I vectors relative to buoy motions increase significantly with buoy speed. No correlation between SSM/I and buoy vectors is observed for speeds below about 3 cm/s and correlation increases significantly above 7.5 cm/s. The results are very sensitive to the compositing scheme used to combine passes into a single sea ice representation. Care must be taken to avoid creation of artificial texture at pass edges and near missing data.

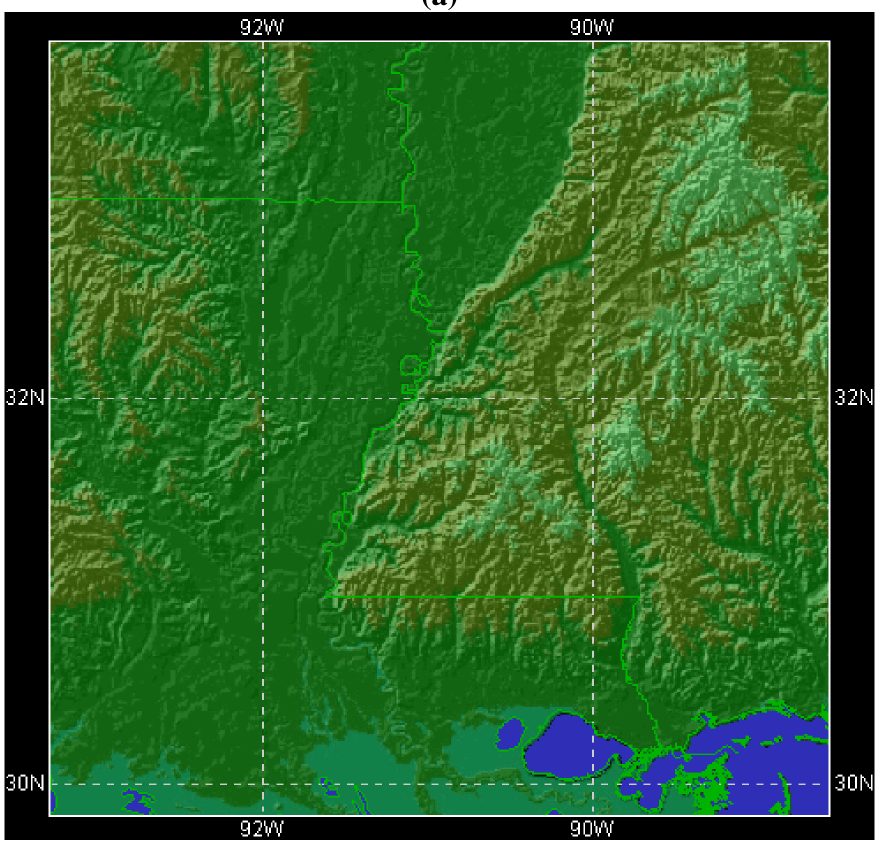
In the second thesis effort, LT Barto reviewed all available terrain datasets such as DTED level 0 and 1, GTOPO30, ETOPO5 and World Vector Shoreline 1999. He used a state-of-the-art geographic information system called ARCVIEW to produce high-resolution terrain dataset that can be used by Joint METOC Viewer. Through LT Barto’s work, two new versions of JMV with enhanced terrain information have already been released by FNMOC.

Barto's thesis added the following capabilities to JMV: Integrated high-resolution coastlines and polygon drawing fills, updated geo-political boundaries and created a method for future seamless National Imagery and Mapping Agency (NIMA) updates by converting software to allow for use instant integration of NIMA datasets, integrated scrolling background topographic and bathymetric databases, integrated high-resolution inland waters globally, integrated contourable background topographic and bathymetric databases with user defined levels, integrated and expanded color fill capability for “on-the-fly” drawing of background fields, designed and integrated background image import interface, and designed and integrated global 1 km terrain database interface.

Figure 1 shows an example of the high-resolution terrain (1 km) now operation in JMV to support the display and interpretation of mesoscale analysis and models.



(a)



(b)

Figure 1. Topographic rendering with JMV 3.4. Image (a) shows rendered topography of the Southeastern United States. Notice the mouse located over Homosassa Springs, FL, and the corresponding readout of 10ft above mean sea level. Image (b) shows a zoomed in section from image (a) of the Mississippi river valley.

IMPACT/APPLICATIONS

Both of these thesis efforts have assisted FNMOC in testing and developing new software to improve the use of FNMOC products. LCDR Carsten provided significant improvement to the SSMI sea ice motion algorithms used to support the Navy Ice Center and LT Barto provided a number of substantial improvements to JMV including state-of-the-art terrain display capabilities and capability to import and georegister .gif imagery for codisplay with other JMV displays.

TRANSITIONS

The revised SSMI sea ice motion system is installed for use at FNMOC. Barto's thesis work has been released to FNMOC users as versions 3.3 and 3.4 of JMV. Version 3.3 was distributed to all JMV users in March 2000 and version 3.4 was implemented in September 2000.

RELATED PROJECTS

This project was also related to the ONR project, "Support of METOC Sabbatical Research and Training ", N0001400WR20027. Some of the NPS theses results supported by this project were briefed and demonstrated by the PI to the METOC centers during the METOC sabbatical.

PUBLICATIONS

Barto, K. P. (2000) Improvements to FNMOC visualization tools for terrain and other parameters. M. S. Thesis, Naval Postgraduate School, June 2000.

Bommarito, B., (1998) A principle component Approach for FNMOC Probability of Precipitation Forecast. M. S. Thesis, Naval Postgraduate School, September 1998.

Carsten, Dave M. (2000): Sea-ice Motion from Buoy and Microwave Satellite Analysis. M.S. Thesis, Naval Postgraduate School, September 2000.

Connon, B. D. (1999) Surface combatant integration of METOC data acquisition and product distribution systems within the IT-21 communications architecture. M. S. Thesis, Naval Postgraduate School, June 1999.

Marsteller, G. F. (1998) Comparison of the NOGAPS Cloud Analyses and Forecasts with the Air Force Real-time Nephanalysis Cloud Model. M. S. Thesis, Naval Postgraduate School, June 1998.

Whalen, J. D., (1998), Comparison of Evaporation Duct Height Measurement Methods and their Impact on Radar Propagation Estimates. M. S. Thesis, Naval Postgraduate School, June 1998.